Intermediate Mass Higgs
160 - 180 GeV

Paul Derwent

- e^+e^- -> ZH M_{Higgs} ~ 160 -180 GeV/c^2
  - ⇒ Higgs ->WW dominates
  - ⇒ bb and ZZ about same order (a few percent)
  - ⇒ Above 200, ZZ ~ 10%
- WANT TO MEASURE:
  - ⇒ BF(H->WW), BF(H->ZZ), BF(H->bb)
  - ⇒ Γ(H->WW), Γ(H->ZZ), Γ(H->bb)
    - » To get couplings
    - » Requires Γ_{TOT}!

  OR

  - ⇒ Γ(H->WW)/Γ(H->ZZ)
    - » Which doesn't require Γ_{TOT}, gives ratio of couplings

- Key piece is σ(e^+e^- -> ZH)

$\sigma(e^+e^- \rightarrow ZH)$

- $M_{Higgs} = 160\ GeV/c^2$
- Use $Z \rightarrow l^+l^-$ and Missing Mass to count Higgs?
  - ⇒ Missing mass is mass recoiling against Z

$$M_{miss} = \sqrt{s - 2\sqrt{s}(E_{l^+} + E_{l^-}) + M_{l^+l^-}{}^2}$$

  - ⇒ High Efficiency, Well Understood systematics in lepton ID
- Procedure:
  - ⇒ Pythia generates ZH, forces Z to e^+e^-, decays Higgs however
  - ⇒ SIMDET
    - » Use energy flow objects to identify electrons SIMDET matches calorimeter and track info to identify particles
      - Ecal > 25 GeV
      - Hcal/Ecal < 0.05
      - 1 track object

Energy Flow and Track Information

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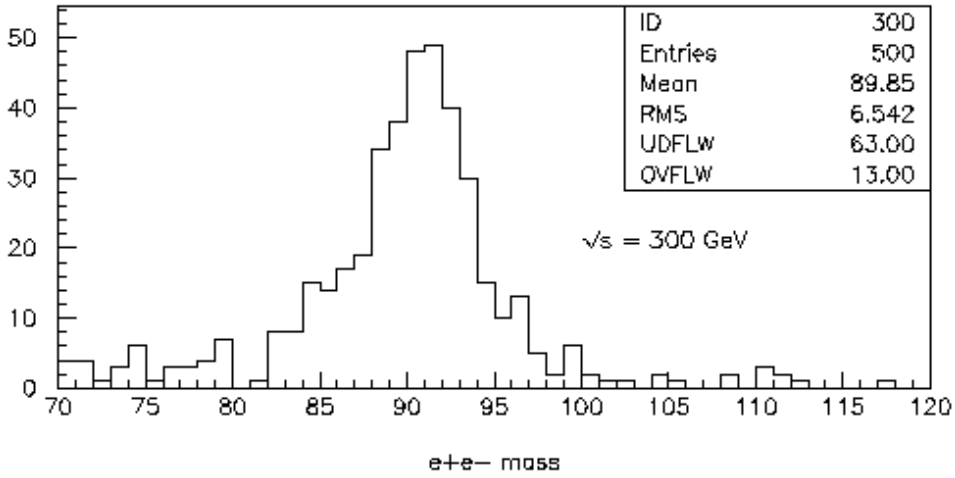
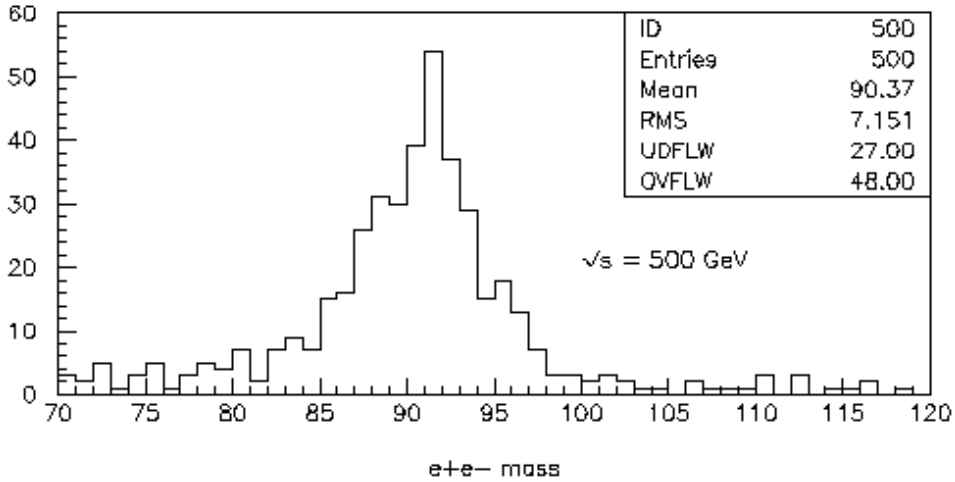
- Common /SIFLOC/
  - ⇒ PECA(5) & PHCA(5)
    - » Energy, θ, ϕ, Time, Prob consistent with em/mip
  - ⇒ PTRK(15)
    - » P, θ, ϕ, charge, IP(rϕ), IP(rz), Cov(9)
    - » IP(rz) and Cov entries are not filled?
  - ⇒ PBST(6)
    - » Px, Py, Pz, E, m, Q best estimates
- Common /PWCPPP/
  - ⇒ PP(10,2000)
    - » Internal particle storage
      - PP(I,0) is generated info
      - PP(I,loccpa) is simulated info (loccpa in Common/SICNTR/)
    - » Px,Py,Pz,E,m,Q,IP(rϕ),IP(rz),Ntrk,Particle ID
      - NB: IP are in units of σ!

e^+e^- Mass distributions

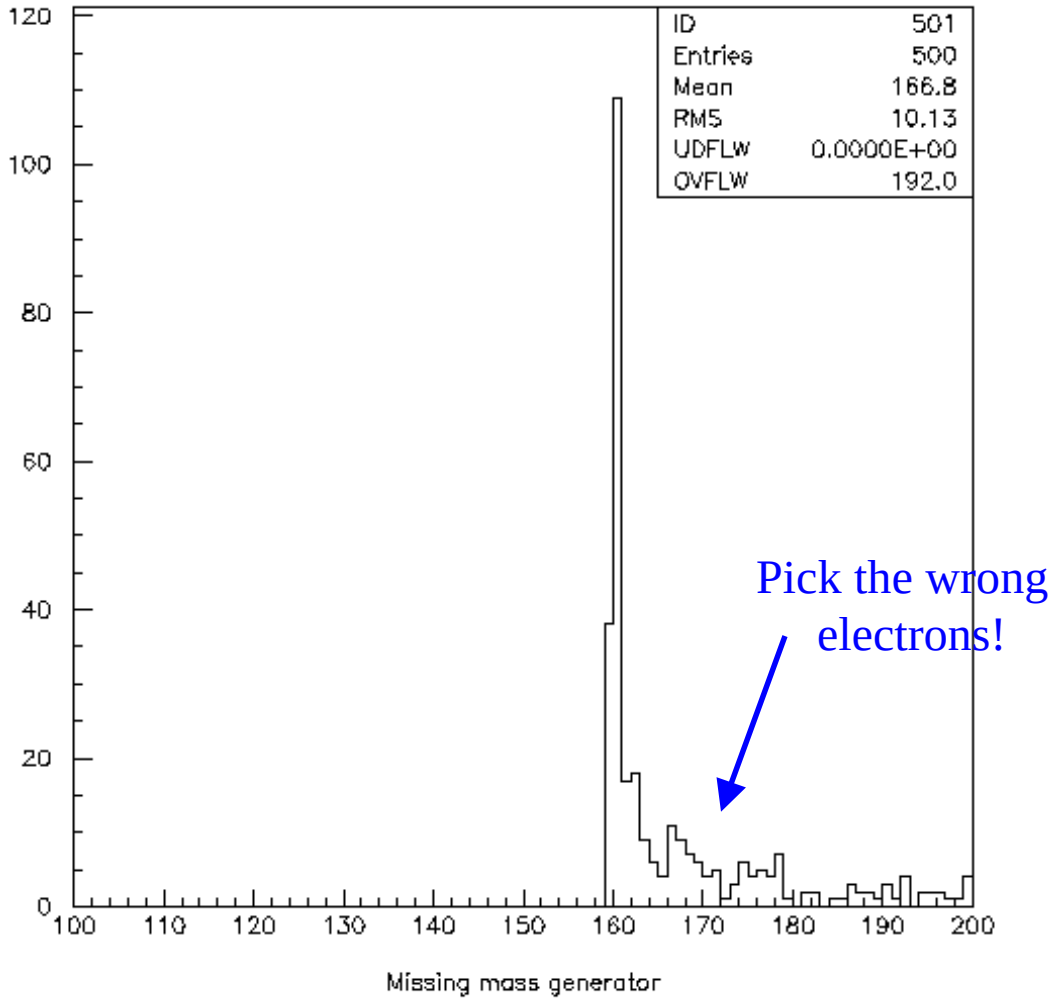
- Mass distribution using 2 highest energy electrons
  - ⇒ Not necessarily from the Z … W decays to electrons also included





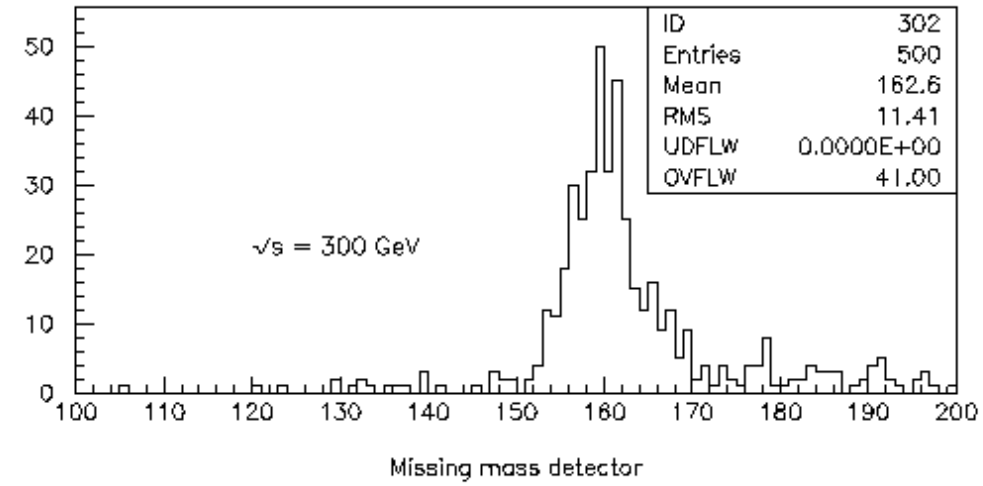
Missing Mass Distribution

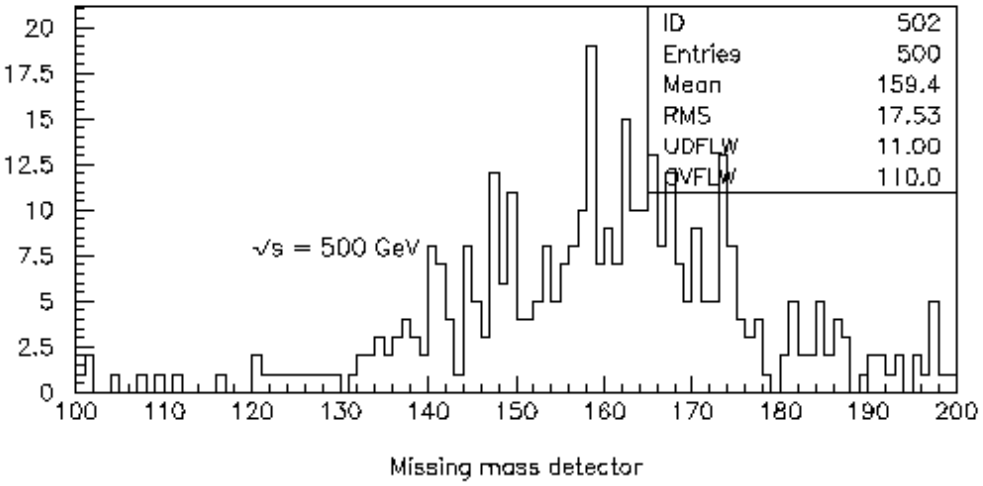
- At Generator Level:
  - ⇒ Everything looks fine



Missing Mass Distributions

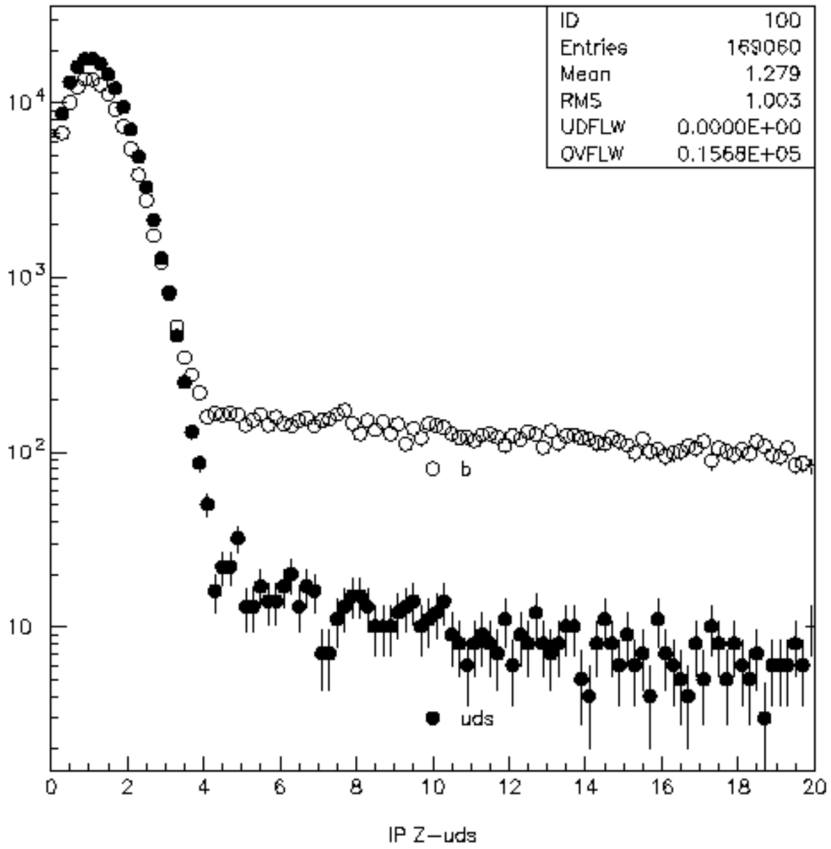
- Missing Mass resolution changes with center of mass energy!





WW ZZ bb finding

- Investigated SIMBTAG routine
  - ⇒ Uses track impact parameters to calculate the probability a grouping of tracks is consistent with coming from the primary vertex
  - ⇒ Developed at ℵ
  - ⇒ Track 3d IP distributions



Jet Probability

- Integrate the track distribution to get track probability

$$P_{track} = \frac{1}{1 + A/B}\left(e^{\left(\frac{-IP^2}{2}\right)} + A/B\, e^{\left(\frac{-B}{IP}\right)}\right)$$

- Use Z-> uds to define the variables
- Combine set of tracks to get the jet probability

$$P_{jet} = \Omega \sum_{k=0}^{N-1} \frac{(-\ln \Omega)^k}{k!}, \text{ where } \Omega = \prod_{1}^{N} P_{track}$$

- Track probability for tracks from the primary vertex is uniformly distributed from 0 to 1 (by construction)
- Jet Probability is also uniformly distributed from 0 to 1 by construction

Track Probability Distribution

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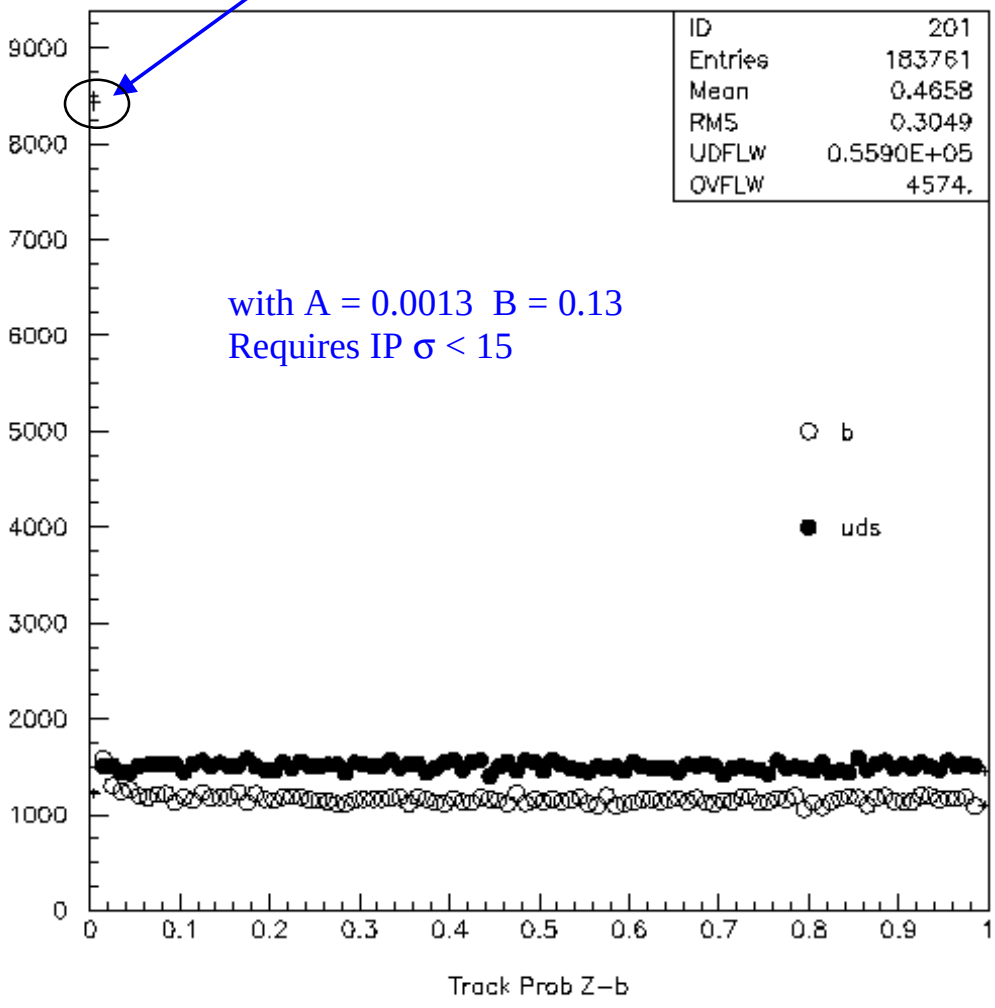
Note this point!
B decay daughters!



Where do we go from here?

- How to pick jets
  - ⇒ For use in W, Z, b identification
  - ⇒ Jet-Jet Mass distributions
- W identification
  - ⇒ Lepton + Missing Energy
  - ⇒ Jet-Jet Mass
- Z identification
  - ⇒ Dilepton mass
  - ⇒ Jet-Jet Mass
- B id
  - ⇒ Define how to pick tracks that enter SIMBTAG